

## CLAIMS

Therefore, having thus described the invention, at least the following is claimed:

- 1     1.     A device, comprising:  
2             an optical interconnect layer including:  
3             a first cladding layer;  
4             a second cladding layer;  
5             at least one waveguide having a waveguide core; and  
6             an air-gap cladding layer engaging a portion of waveguide core,  
7     wherein the first cladding layer and the second cladding layer engage the  
8     waveguide.  
  
1     2.     The device of claim 1, wherein the device is chosen from a backplane, a  
2     printed wiring board, and a multi-chip module.  
  
1     3.     The device of claim 1, further comprising, at least one coupler element  
2     disposed adjacent to the waveguide core.  
  
1     4.     The device of claim 1, further comprising:  
2             a first sacrificial layer that can be removed to form the air-gap cladding  
3     layer.

1     5.     The device of claim 4, wherein the first sacrificial layer is chosen from  
2           polynorborenes, polyoxymethylene, polycarbonates, polyethers, and  
3           polyesters.

- 1     6.     An optical interconnect layer, comprising:  
2                a first cladding layer;  
3                a second cladding layer;  
4                at least one optical dielectric waveguide having a waveguide core; and  
5                an air-gap cladding layer engaging a portion of waveguide core,  
6     wherein the first cladding layer and the second cladding layer engage the  
7     waveguide.
- 1     7.     The optical interconnect layer of claim 6, further comprising a substrate made  
2     of a dielectric material.
- 1     8.     The optical interconnect layer of claim 6, wherein the first cladding layer is  
2     chosen from polyimides, polynorborenes, epoxides, polyarylenes, ethers, and  
3     parylenes.
- 1     9.     The optical interconnect layer of claim 6, wherein the second cladding layer is  
2     chosen from polyimides, polynorborenes, epoxides, polyarylenes, ethers, and  
3     parylenes.
- 1     10.    The optical interconnect layer of claim 6, wherein the air-gap cladding layer  
2     has a height from about 1 to about 100 micrometers.

1 11. A method for monolithically fabricating an optical interconnect layer  
2 comprising:  
3 (a) disposing at least one waveguide core on a portion of a first  
4 cladding layer;  
5 (b) disposing a sacrificial layer onto at least one portion of the first  
6 cladding layer and a portion of the waveguide core;  
7 (c) disposing an second cladding layer onto the first cladding layer and  
8 the sacrificial layer; and  
9 (d) removing the sacrificial layer to define an air-gap cladding layer  
10 within the first cladding layer and the second cladding layer, and wherein the  
11 air-gap cladding engages a portion of the waveguide core.

1 12. The method of claim 11, further including:  
2 forming a volume grating layer adjacent to the waveguide core after (a)  
3 and before (b).

1 13. The method of claim 12, further including:  
2 forming at least one volume grating coupler element.

1 14. The method of claim 11, further including:  
2 integrating the optical interconnect layer into a device chosen from a  
3 backplane, a printed wiring board, and a multi-chip module.

1     15.     A method for fabricating a device having an optical interconnect layer  
2             comprising:  
3                 disposing at least one waveguide core on a portion of a first cladding  
4             layer;  
5                 forming at least one volume grating coupler element adjacent the  
6             waveguide core;  
7                 disposing a sacrificial layer onto at least one portion of the first  
8             cladding layer and a portion of the waveguide core;  
9                 disposing a second cladding layer onto the first cladding layer and the  
10            sacrificial layer;  
11                removing the sacrificial layer to define an air-gap cladding layer within  
12            the first cladding layer and the second cladding layer, and wherein the air-gap  
13            cladding engages a portion of the waveguide core; and  
14                attaching the optical interconnect layer to a device chosen from a  
15            backplane, printed wiring board, and a multi-chip module.

1     16.     The method of claim 15, wherein the sacrificial layer is chosen from  
2             polynorborenes, polyoxymethylene, polycarbonates, polyethers, and  
3             polyesters.

1     17.     The method of claim 15, wherein the waveguide core includes a transparent  
2             dielectric material.

1     18.     The method of claim 15, wherein the first cladding layer is chosen from  
2             polyimides, polynorborenes, epoxides, polyarylenes, ethers, and parylenes.

- 1 19. The method of claim 15, wherein the second cladding layer is chosen from  
2 polyimides, polynorborenes, epoxides, polyarylenes, ethers, and parylenes.